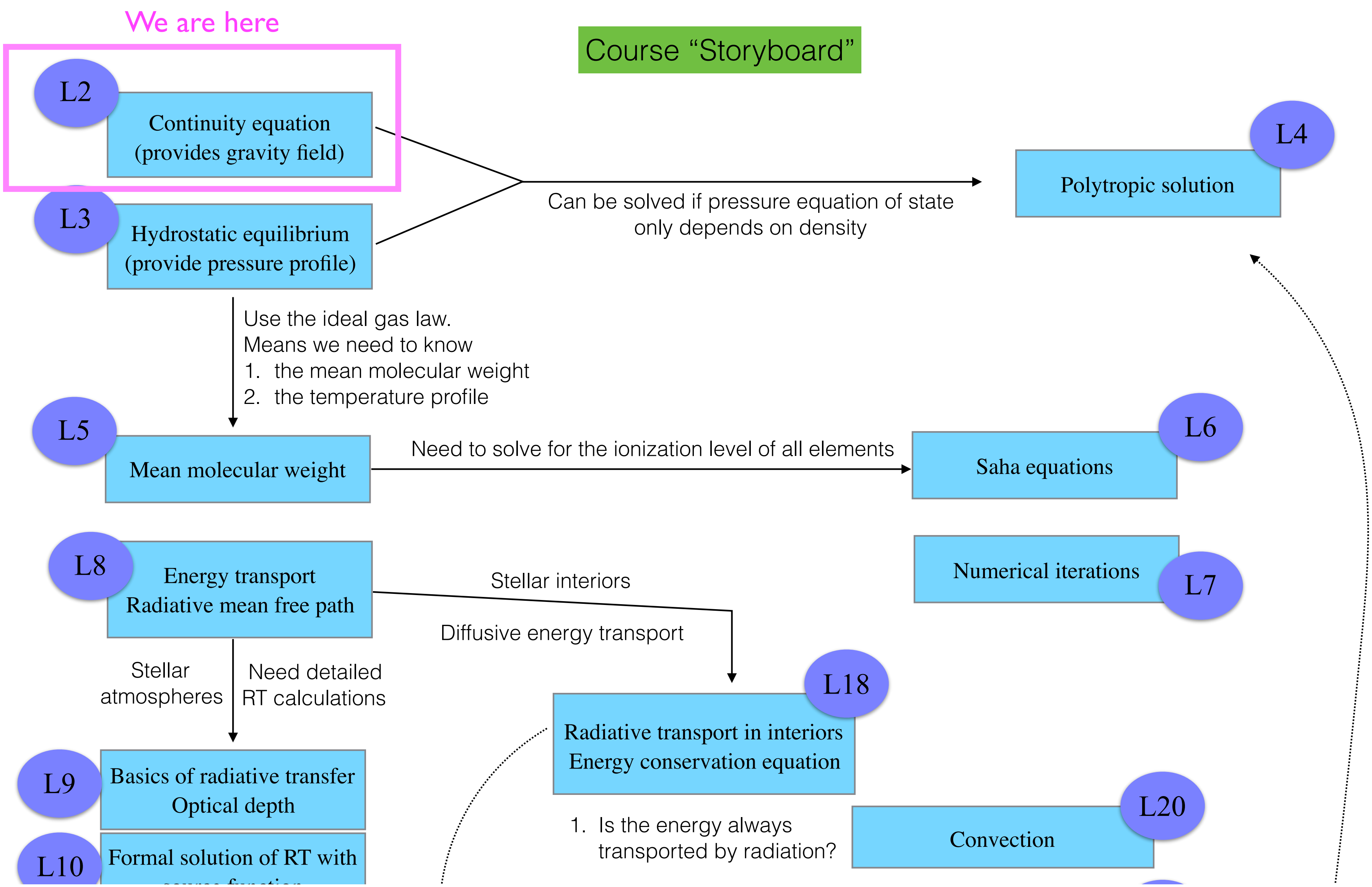
Week 1 Thursday
L-2
Gravity field



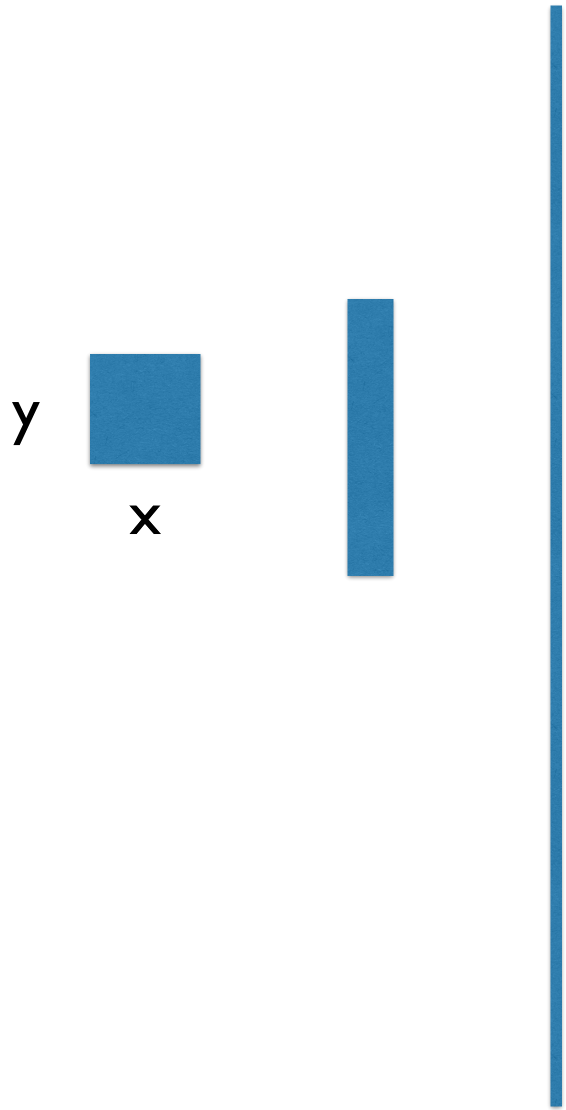
We are here
Course "Storyboard"
L2
Continuity equation (provides gravity field)
L3
Hydrostatic equilibrium (provide pressure profile)
Can be solved if pressure equation of state only depends on density
L4
Polytropic solution
Use the ideal gas law.
Means we need to know
1. the mean molecular weight
2. the temperature profile
L5
Mean molecular weight
Need to solve for the ionization level of all elements
L6
Saha equations
Numerical iterations
L7
L8
Energy transport
Radiative mean free path
Stellar interiors
Diffusive energy transport
Stellar atmospheres
Need detailed RT calculations
L18
Radiative transport in interiors
Energy conservation equation
L9
Basics of radiative transfer
Optical depth
1. Is the energy always transported by radiation?
L20
Convection
L10
Formal solution of RT with

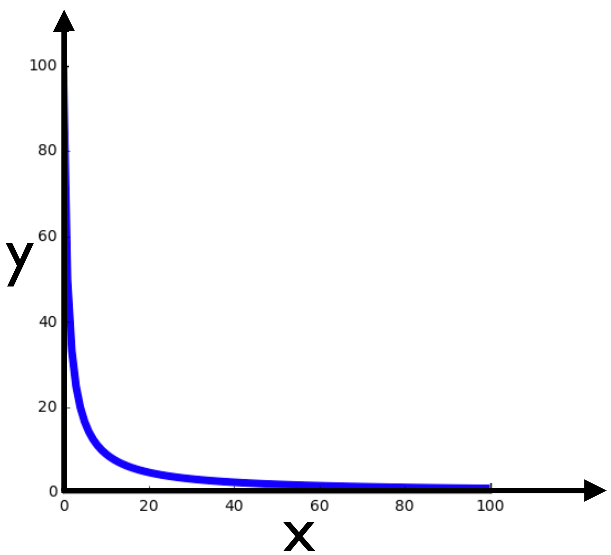
A short reminder of two important math concepts

I want an area of 100m^2.

$$x * y = 100$$

One equation, two unknowns





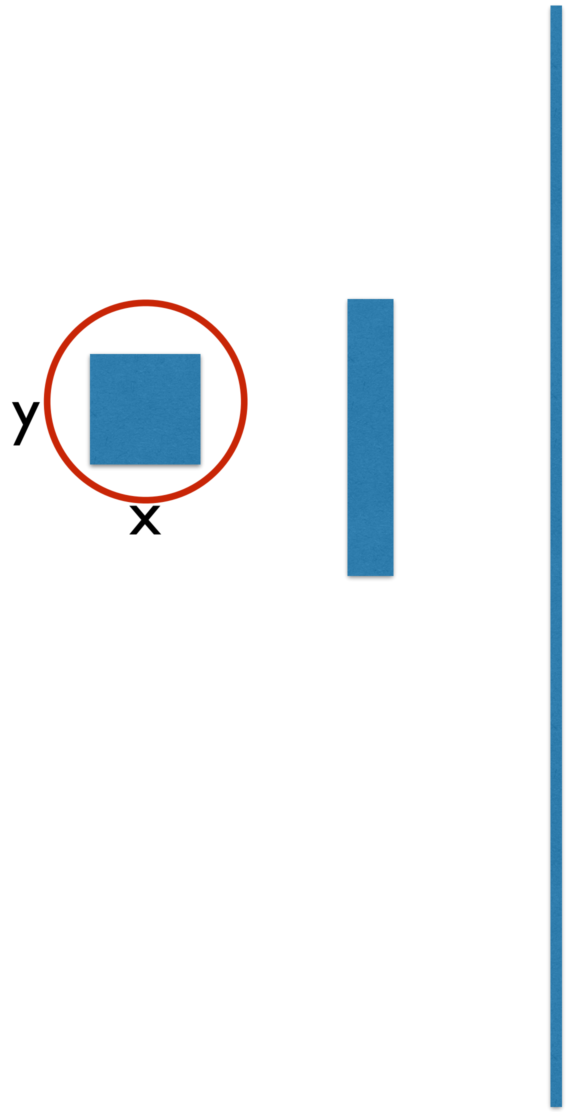
I want an area of $100m^2$.

$$x * y = 100$$

I want a square

$$x = y$$

Two equations, two unknowns



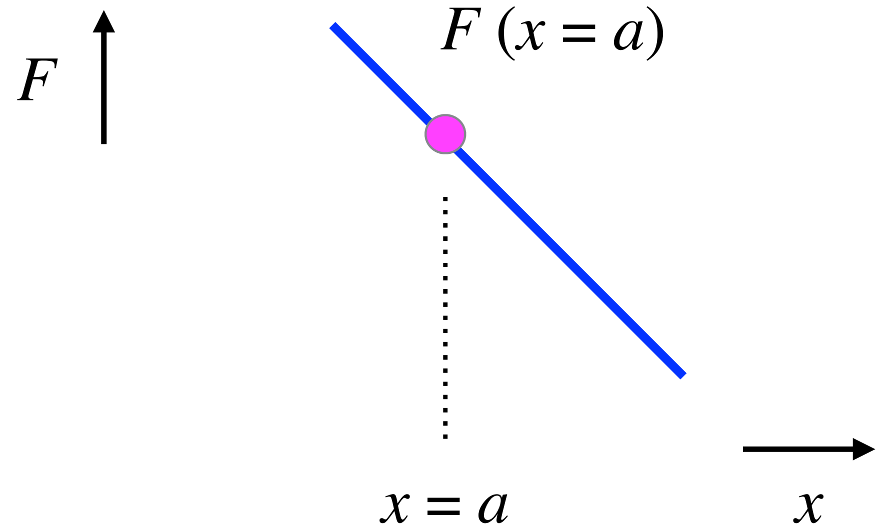
$$\int dF \neq F$$

$$\int_{1}^{2} dF = F(2) - F(1)$$

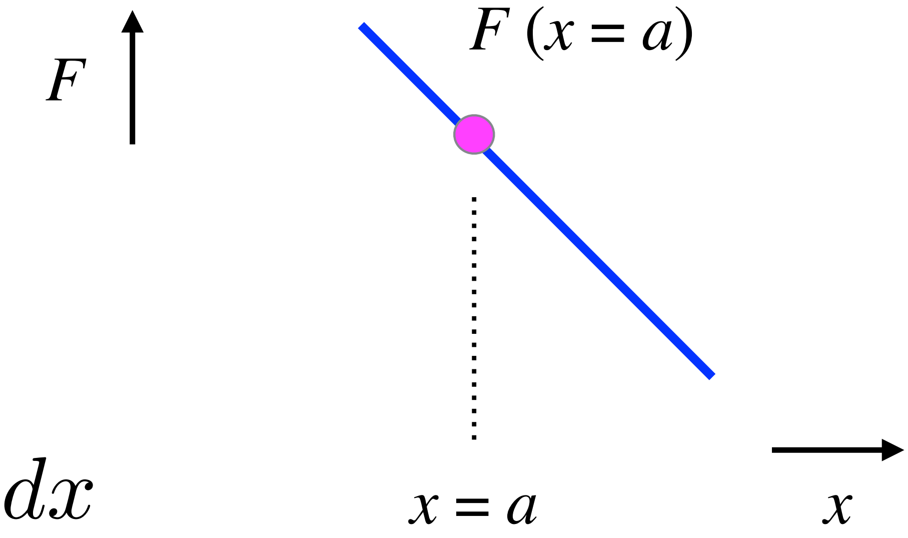
$$\frac{dF}{dx} = -1$$

$$\int_{1}^{2} dF = -1 \int_{1}^{2} dx$$

$$F(x = a) - F(1) = -1 \int_{x_1}^{x=a} dx$$



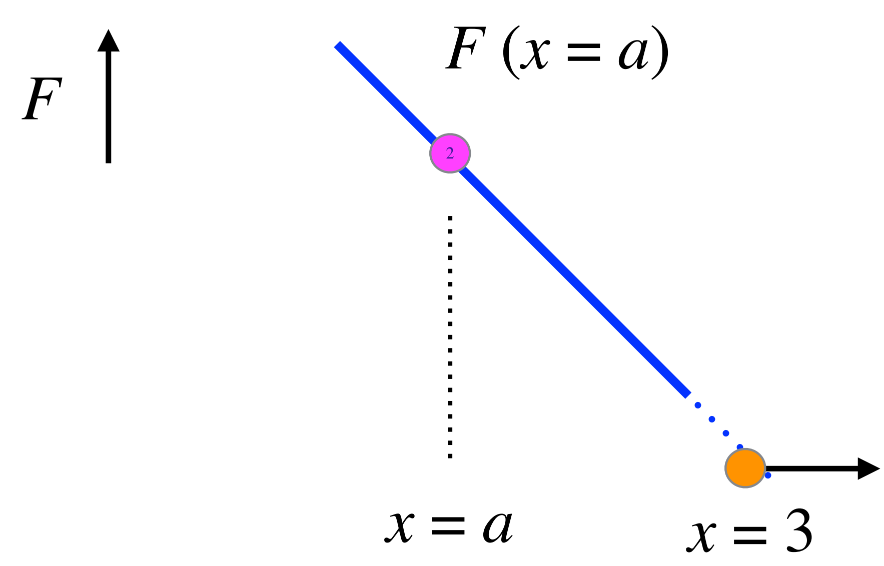
$$\underline{F(x \overset{2}{=} a)} - \underline{F(1)} = -1 \int_{\underline{x_1}}^{x=a} dx$$



One equation, three unknowns

$$\underline{F(x \overset{2}{=} a)} - \underline{F(\overset{}{1})} = -1 \int_{\underline{x_{1}}}^{\overset{2}{x=a}} dx$$

$$F(\overset{2}{x} = a) - \overset{1}{0} = -1 \int_{\underset{1}{x=3}}^{\overset{2}{x=a}} dx$$



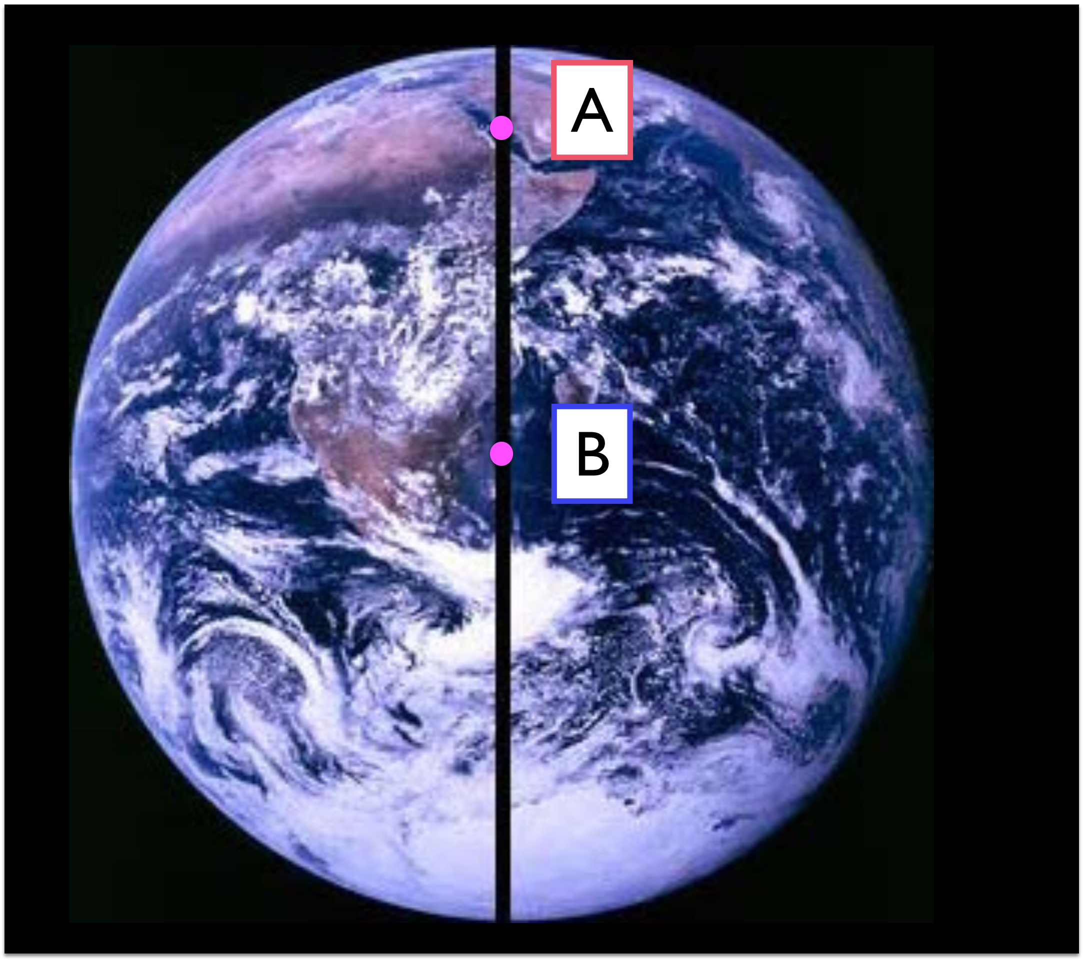
The lower bound of an integral is not always zero!!

$$F(x) - 0 = -1 \int_{3}^{x} dx'$$

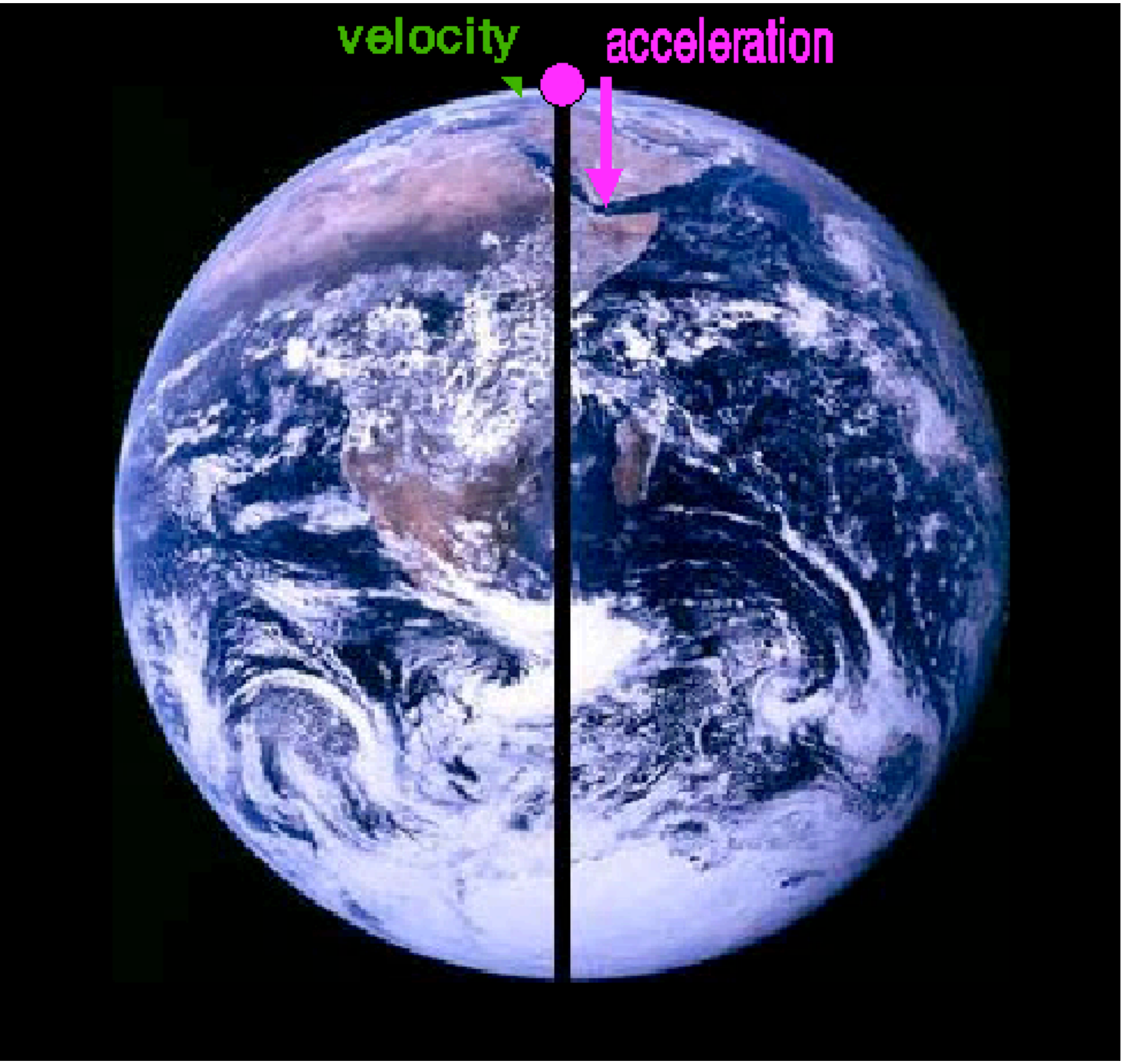
A star is a massive ball of gas => there has to be gravity!

You are throwing a ball in a the tunnel through the center of the Earth…

Where is the <u>magnitude</u> of the gravitational acceleration of the ball the smallest?



C :The same everywhere


velocity
acceleration

On the board:

* The gravitational acceleration inside an object $g(r)$
* The enclosed mass 'coordinate' $M_r(r)$

* What if the density is not constant (i.e. $\rho = \rho(r)$)?

=> The mass-continuity equation: $\dfrac{dM_r}{dr} = 4\pi r^2 \rho(r) dr$

* The case of constant density (graphs of $M_r(r)$ and $g(r)$ in notebook)
  => Practicing using change of variable to integrate unit-less quantities

* An example case of a decreasing density law: $\rho(r) = \rho_0 \left(1 - \dfrac{r}{R_*}\right)$.
  => At home: add graphs to notebook.